# THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND THE EXPLORATION OF SPACE

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Deputy Administrator
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(Luncheon Talk, American Rocket Society, New York, N. Y., November 18, 1958)

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May I first extend my congratulations to the American Rocket Society for the contributions made by its members to the technology of our time, in particular for the tools which you have developed which make possible the exploration of nearby space now and of the entire solar system in the not too distant future.

The propulsion system has always been a dominant element in the progress of transportation, very largely determining the performance of the transport vehicle as regards load carrying ability and speed. Over the centuries performance has increased in an evolutionary manner punctuated by large step-like jumps, as radically improved propulsion systems became practical. The internal combustion engine provided the means for high speed ground transport and enabled man to leave the surface of the earth to travel through the air. These engines advanced in performance as the number of cylinders and the compression ratio were increased and as the fuel was improved. In recent years the pace has accelerated. There came the marked increase in power and decrease

in weight of the jet engine, with consequent increase in speed and altitude of aircraft propelled by such engines. Speeds faster than sound became practicable.

The utility of propulsion systems of advanced performance has been intimately dependent on simultaneous developments in other branches of technology. Thus jet engines had limited application until we learned to postpone compressibility effects and to reduce transonic drag by sweep-back, by reducing the thickness of wing sections, and by distributing cross-sectional area of the entire configuration of the vehicle according to the "area rule". These aerodynamic improvements were in turn dependent on the development of new materials and structural designs and the solution of aeroelastic and flutter problems.

Now in the past 10 or 15 years we have reached a state of technological development where the rocket comes into its own. The principles of rocket propulsion have long been known. Practical rockets of small size were developed centuries ago. I need not review the history of rocket development which is well-known to you, nor the early speculations as to their application to space propulsion. Suffice it to say that we now have large rocket engines which can boost test objects into regions of space where air resistance becomes extremely small and the forces of gravitational attraction and inertia are predominant. With the launching of the first man-made earth satellite on October 4th of last year, the unmanned exploration of space began. Manned exploration is not too many years distant.

I would not underestimate the necessary advances in hypersonic aerodynamics, in means for dealing with aerodynamic heating, in materials, and in structures needed to improve our capabilities in space exploration. Yet I would emphasize that whether the vehicle is intended for greater speed and range in the solar system or for carrying greater loads at the lower speed and to a shorter range, increased capabilities depend on the development of even greater thrust than available in present ballistic missile rockets. The next reasonable goal appears to be a thrust of the order of one-million pounds in a rocket using chemical propellants.

Beyond the further development of chemical rockets, space propulsion will require other types of powerplant which will come to maturity as space technology advances. The potentialities of nuclear rockets for greater performance as regards higher speeds and larger vehicles are already under investigation. Once space vehicles have completed the first phase of their journey out of the region of large gravitational attraction toward the earth, propulsion will no longer require an engine of large thrust and economical consumption of propellant will be the controlling consideration. Various forms of electrical propulsion are under investigation for this application. As these propulsion systems become practicable, perhaps the American Rocket Society may wish to change its name, although I notice no hesitation now to include these systems within the scope of your discussions.

The American Rocket Society has taken an active part in the inauguration of the Age of Space Exploration and in the discussions leading

up to the establishment of the National Aeronautics and Space Administration. I thought it might be useful to you to bring together in one place information on the development of the organization of NASA since its formal establishment on October 1st.

The initial organization of NASA provides for four principal areas of activity, --- space flight development, aeronautical and space research, program planning and evaluation, and business administration.

Activities in space flight development include the design and procurement of rocket engines, vehicle components, complete vehicles, and payloads; launching and operation of space vehicles for research purposes; and the accumulation and reduction of data obtained in research flights of space vehicles. The payloads may include scientific instruments for the study of the space environment and of the moon and the planets, apparatus for the practical use of satellites in long-range communications and meteorological observations, and in some cases man himself.

The former NACA research laboratories are now the NASA research centers for the conduct of programs of basic and applied research in support of aeronautics and space science and technology, more specifically in aerodynamics and space mechanics, propulsion, materials, structural statics and dynamics, and operating problems. Additional effort in these and other pertinent fields of science and technology will be supported in the laboratories of industry, educational, and non-profit institutions.

The office of Program Planning and Evaluation, as its name indicates, will, in close consultation with the Department of Defense and the scientific community, develop a comprehensive national space program for the longer range for consideration of the National Aeronautics and Space Council and will evaluate the progress of current programs as a staff source to the Administrator of NASA.

The business functions, conducted by the Director of Business Administration, include the development of fiscal and budgetary policies, of contracting policies and their implementation, personnel administration, plant operation, safety, security, and the administrative policy guidance for the decentralized operation of NASA's research centers and field stations. It has been announced that NASA will follow the Armed Services Procurement Regulations for its development and procurement contracts insofar as possible.

The legal functions are assigned to the General Counsel and the public informational activities to the Director of Public Information, each responsible directly to the Administrator.

The Administration was organized in the environment of an established civil space program initiated by the Advanced Research Projects Agency of the Department of Defense under legislation passed last year. The President, by Executive Order, has transferred responsibility for these projects and for the Vanguard program to NASA, including in the case of Vanguard the civilian personnel, records, property, facilities, and the IGY tracking network. The President also transferred

from the Air Force to NASA responsibility for the one-million pound booster development, certain high energy booster projects and the support of the non-nuclear aspects of the Rover program conducted by AEC to develop a nuclear rocket.

The transfer of the Vanguard group brought into NASA a capability in the space science field and in tracking and data acquisition. This group, now housed at the Naval Research Laboratory, will ultimately be located at NASA's Space Science Center, at Beltsville, Maryland, when completed.

Some additional in-house capability in electronics, communication and guidance, and in vehicle systems is required and means for meeting these needs are under discussion. Most of the work in space flight development and operation will be conducted by existing industry, university, non-profit institutions, and governmental agencies under contracts to NASA.

The National Aeronautics and Space Act of 1958 established the National Aeronautics and Space Council in the Executive Office of the President with the President himself as chairman. The other members are the Secretary of State, the Secretary of Defense, the Chairman of the Atomic Energy Commission, the Administrator of NASA, another government member, --- at present the Director of the National Science Foundation, --- and three members from private life appointed by the President. The present members in this category are D. W. Bronk, W. M. Burden, and J. H. Doolittle. The Council advises the President, to whom responsibility is assigned by the Act for the survey of aeronautics and space activities of all governmental agencies, formulation of a

national program, assignment of responsibility to the several agencies, and the settlement of controversies. The Council has held two meetings, and meets approximately once a month.

The Act also established a Civilian-Military Liaison Committee with a chairman appointed by the President. Mr. W. M. Holaday has been appointed to this post and eight members have been appointed, four from NASA, and one each from the Department of Defense, Army, Navy, and Air Force. These members are myself, I. H. Abbott, A. Silverstein, and Homer Joe Stewart from NASA, Roy Johnson from the Department of Defense, Major General R. Swofford from the Air Force, Vice Admiral R. B. Pirie from the Navy, and Major General W. W. Dick from the Army. This Committee will hold its first meeting shortly. Its function is to serve as a formal channel for coordination and as a means of keeping each agency informed of programs of the other.

I can assure you that the staff of NASA is extremely busy in keeping the inherited programs under full speed, initiating an immediate follow-on program, completing its organization, and planning for the longer term. Now is budget time with many discussions of detailed programs, general level of support, coordination with programs of the Department of Defense, and preparations for Congressional hearings.

Under these circumstances I will close this discussion by quoting in part from the prophecy prepared for and published in the November issue of your magazine Astronautics.

"It is easier to prophecy what can be rather than what will be. For what will be depends on the sacrifices that our people and those of other nations are willing to make to devote their wealth, skill and labor to explore this new frontier in the absence of the promise of early returns on the investment. Will we, like Queen Isabella of old, devote a considerable fraction of the national wealth to expeditions to search out the unknown?

"There lie ahead a number of new roads into the unknown, and we can travel any or all of them. The one that seems most essential and basic is the development of greater propulsion capability, without which our progress will be slim and limited. In a few years, we can have thrusts of several million pounds in chemical rockets; in a decade, nuclear propulsion of still greater capability; and after that, true space propulsion systems of the ion or plasma type. In 25 years, we can have propulsion systems adequate for space vehicles traveling within our solar system.

"The probing of our solar system by instrumented and automated vehicles can be far advanced in 25 years, sufficient to map out the radiation field, electric and magnetic properties in space and near the planets, neutral and charged particles, other physical and chemical characteristics of the space environment, and much information

about the planets. Astronomy can be revolutionized. No one knows what new phenomena are still to be discovered or the depth of understanding of the universe still to be attained.

"Another prominent road is that of manned vehicle development. We hope to have a man circle the globe in a satellite within a few years. In 25 years, we can have closed ecological systems permitting very long sojourns in space vehicles and we can land and return men from the moon and the nearby planets.

"In 25 years, we can use space vehicles for extensive systems of communications and meteorological observations, and perhaps other peacetime purposes. In this period, we can discover and develop military weapons.

"All these things and others can come to pass and can profoundly affect our intellectual and spiritual outlook, as well as modify our daily lives as much or more than has the development of aviation."

Whether these things will come to pass will depend on the support given and the wisdom and efficiency of your operations and ours.